Adaptability in Residential Adaptive Reuse

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This research complements existing LASG focuses on experimental constructional systems, especially relating to the LASG Scaffolds stream. Finding feasible and applicable strategies for improving resilience and empowering adaptability in the built environment are the objectives of this research and are aligned with the long-term objectives of the LASG. Residential adaptive reuse and ideas of adaptability integrated within the refurbishment of existing residential buildings will be examined in this paper. The potential for existing buildings to be extended and renewed by repurposing and adjusting outer layers of envelope and balconies will be addressed. Within the Scaffolds stream, a main focus is on the constructional systems and spatial qualities of envelopes and skeleton systems that will be needed to support dynamic movement and programming with multiple functions. This research contributes to a practical base that can provide opportunities to implement LASG systems at full public scale.
Introduction

Tall concrete structures have prevailed as the main type of multi-family housing construction in Canada since the 1950s. While environmental performance and contextual relevance in aging multi-family housing are well-known issues, balcony degradation specifically contributes to high levels of structural failures, low energy performance, and inefficient use.¹ Some efforts have been undertaken to improve environmental performance and contextual relevance of existing towers including balcony reconstruction, recladding, system upgrades, and interior renovations.² While these strategies are necessary for addressing existing challenges, incorporating systems that are able to accommodate future adaptive reuse can help anticipate density, and social and technological changes.³ It is expected that integrating wholistic adaptive reuse strategies that can address long-term adaptability will have an impact on the longevity, sustainability and resilience of residential towers.⁴

Context

From the 1950s onwards, planning and cultural changes have varied the form and context of the concrete residential towers, from towers-in-the-park to urban point towers and tower-podiums. Changes in ownership models have evolved from predominantly rental buildings in mid-20th century to an individual condominium ownership market in the past two decades, with an increase in rental tower construction in recent years.⁵ Varied ownership models have greatly affected the demographics that these tall residential buildings attract over time. Building envelope technology and market demands have also influenced the materiality and aesthetics of residential towers.

While changing demographics and occupant structures are a characteristic of multi-family residential neighbourhoods, they are inherently rigid in use and structure, and are therefore prone to obsolescence.⁶ Building obsolescence is directly related to the shortcomings of designing prescribed housing arrangements and their limited life cycles, causing about 60% of all building demolitions in North America.⁷ Designing buildings that meet the needs of one specific type of household and respond to short-term economic needs instead of being able to react to changing demands of the occupant and the future market⁸ is a driver of this obsolescence. Building

² Kesik, T.J. 1954-2009, Tower renewal guidelines for the comprehensive retrofit of multi-unit residential buildings in cold climates, Daniels Faculty of Architecture, Landscape, and Design, University of Toronto, Toronto.

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Adaptability can be a practical solution to overcoming the problem of building redundancy. The obsolescence and redundancy of existing dated residential building stock is identified as a critical issue for sustainable development. Between 1915 and 1950, 40-60% of all homes in Southern Ontario were built by owners, often incrementally and adapting over time. By 2006, less than 1% of homes in the region were built by owners. This divide between occupants and their built environment, and the rigidity of the built environment in responding to occupant needs is a main driver of obsolescence. Other factors can include increasing rate in varying working circumstances, living arrangements, family structure, consumer needs, changing policy, and technology.

Adaptability in Adaptive Reuse of Existing Buildings

Adaptive reuse is defined across multiple studies as an environmentally sustainable alternative to both demolition and new construction. Adaptive reuse strategies extend the functional life of existing buildings that are either failing in adequate building performance or are obsolete in use through reuse or repurposing. This can be defined in terms of a range varying from...
repurposing of main structure to materials and systems. It can be concluded from studies in this field that successful adaptive reuse projects can result in notable social, economic and environmental benefits.

In most literature, “adaptability” is used to explain the capacity for change within the occupant’s use, whereas “flexibility” addresses physical change of the built environment as a response to the occupant’s use. Adaptable buildings are defined as structures that incorporate alteration strategies, allowing them to respond to changing environments and occupant requirements. To be truly sustainable and resilient, a building design must account for future flexibility and opportunities to adapt to occupants’ demands and to enable accommodation of future uses. Considering the importance of adaptive reuse and the need to address the changing housing market, integrating adaptive strategies in future adaptive reuse is integral to developing buildings that are responsive to environmental and demographic changes.

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There are many identified effective design-based strategies for enabling adaptability. Some of these include the layering of different building systems, accurate documentation, over-designing structural capacity, designing for disassembly, simplicity of structure, systems and plan, modularity, open layouts, and occupant participation. Amongst these, open and accessible plans, over-designing structural capacity, and layering are highlighted by the industry as the most effective strategies to making future adaptive reuse possible.
Objectives of Residential Adaptability

Increasing sustainability through adaptability requires improvements on life cycle, economic performance, quality and liveability, and reduction of waste to landfills. These strategies can lead to sustaining of embodied energy and resources, retention of carbon and cost savings contributing positively to environmental sustainability. Continuous adaptation as per changing occupants’ needs and environmental requirements is important for the overall resilience and life expectancy of the built environment. The UK government’s Strategy for Sustainable Construction highlights the importance of research, development and demonstration of “adaptation techniques and durable systems to improve the built environment’s ability to deal with the impacts of climate change.” Many government mandates to reduce carbon footprint also support the important development of further legislation that encourage the upgrades to meet new standards in existing buildings. While highlighting the importance of adaptability in sustainability and resilience, it is important to note that there is very little attention given to the carbon benefits of this process. The environmental benefits of adaptability and adaptive reuse go unmeasured by most environmental legislation and available environmental frameworks. UK BREEM certification is one of the only legislations that takes adaptability of a building into account in the ‘waste’ category, with minimal influence on the overall score.

Adaptability in the residential context is often used by developers to revise and finalize units corresponding to changing market demands leading up to construction. The Architectural Association building in London, and the joining of eight dwellings that make up the entirety of a school without disrupting the urban fabric, is another example of implementing flexible strategies. Interchangeable components, layering of building elements, and designing for disassembly are highlighted in literature as the most prominent contributors to successful residential adaptation. Separation of wet cores, structures and systems in units is also a feature of adaptable residential buildings. These will enable the combination of units to accommodate growing families or multi-family living arrangements. These strategies have been implemented in the works of Yositika Utida in Japan, Marc Koehler Architects in the Netherlands and recent residential developments by JvN Developments Inc. in Canada (Image 1-2). While these examples illustrate adaptability strategies in new buildings, similar concepts can be implemented in the adaptive reuse of existing residential buildings.
Implementation Challenges

The implementation of adaptable strategies, specifically in the residential context, encounters the lack of evaluation metrics for adaptive strategies and their economic results. The concept of Open Building design advocates for building adaptability. The ability is principally rooted in separating different building elements in layers that can be maintained, reimagined and changed without affecting the others to significantly reduce cost and time. While the Open Building Design advocates have been successful in defining some adaptive design strategies, their approach is limited by their lack of defined evaluation criteria.

Specifically, evaluation tools for design strategies, social implications, as well as economic and market barriers are required to facilitate adaptable building strategies. In terms of social sustainability, significance of changing demographics and changing occupancy requirements need to be taken into account. There also needs to be a differentiation between the immediate impact of adaptability, including cost and ease of change, and the imminent impact of continuous alteration on the building.

Future Research

Strategies for adaptability in the residential context, including the integration of interchangeable and responsive components, layering of building elements, and designing for disassembly (Gosling et al., 2013) (Ross et al., 2016), and how each enhances long-term building performance and adaptability by different measures (Wilkinson, 2014), will be further examined. Evaluation parameters including environmental performance, life-cycle cost, economic valuation, and constructability, among other parameters, need to be analyzed in order to determine the efficacy of adaptable strategies.

Other considerations for further research include understanding the economic and cost implications, and strategies to implement adaptability in existing buildings as adaptable retrofits (Gosling et al., 2013). Ultimately, findings from the research will define frameworks for future adaptation of residential buildings.
Sheida Shadi earned her B.AS. and M.Arch from the University of Waterloo’s School of Architecture. She is now pursuing her PhD in Civil and Environmental Engineering under the co-supervision of Professor Carl Haas and Professor Philip Beesley. Shahi was a researcher at Diamond Schmitt Architects in Toronto and at Waterloo School of Architecture’s Living Architecture Systems Group.

Her research focuses on strategies for adaptive reuse of balconies using intelligent building systems integration for improved environmental and structural performance. The goals of this project are to investigate the role of smart systems, information technology, data collection and citizen participation in informing adaptive reuse, and to develop design prototypes for balconies as smart integrated systems.

Additional References
